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Figure: Site Location Map

## ENVIRONMENTAL ASSESSMENT

### I. PURPOSE AND NEED

A. TITLE: Integrated Pest Management of Noxious Weeds on Malheur National Wildlife Refuge, Burns, Oregon

B. Vicinity Description: Malheur Refuge is located in southeastern Oregon approximately 30 miles south of the town of Burns, at an elevation of 4,100 feet. The refuge is 41 miles long, 37 miles wide, and covers 183,000 acres. It is comprised of vast shallow marshes, small ponds, irrigated meadows, alkaline lakes, and grass and sagebrush upland interspersed with occasional greasewood covered alkali flats.

Malheur National Wildlife Refuge was established in 1908 by President Theodore Roosevelt and is one of over 400 refuges nationwide. Malheur was set aside primarily as a nesting area for migratory birds, but it is also an important fall and spring gathering point for waterfowl of the Pacific Flyway migrating between northern breeding grounds and California wintering areas.

Climate is semi-arid with annual precipitation averaging only 9 inches. Winters are cold and the summers warm and dry. Sub-zero temperatures are common most winters. Summer maximum temperatures seldom exceed 90°F. Most precipitation occurs from November through January as snow and May to June as spring rains.

The refuge lies within the closed Harney Basin and has no outlet to the ocean. The three main basin drainages are the Blitzen River from the south; Silvies River from the north; and Silver Creek from the northwest. Harney Lake, located on the refuge, is the sump or lowest point in the entire Basin drainage.

The refuge is located entirely within Harney County, a vast sparsely populated area of approximately 6,500,000 acres and 8,000 people, most of whom live in the adjacent towns of Burns (3,575) and Hines (1,600). In the southern portion of the county near the refuge, the primary industry is agriculture (hay, grain, and beef cattle production). In the northern portion, north of Burns, lumber is the primary industry on lands which are predominantly National Forests.

- C. Need: The management objectives of Malheur Refuge are varied and include the preservation of unique ecological areas, such as Malheur and Harney Lake, and the development and/or maintenance of wildlife habitat to provide maximum wildlife diversity. Habitat management includes practices such as cattle grazing, haying, burning, and farming.

There are plant species found in Harney County and on Malheur Refuge which are known to cause economic losses to ranchers and farmers. On Malheur Refuge, these plants are Canada thistle (Cirsium arvense), whitetop (Cardaria draba), and perennial pepperweed (Lepidium latifolium).

Canada thistle is well established in the upper Blitzen Valley between Buena Vista sub-headquarters and Frenchglen. The weed is most prevalent on previously disturbed sites such as dikes, roadsides, ditch banks, and nesting islands. Thistle occurs in many fields and meadows, some of which received heavy grazing and other forms of disturbance in the past. Canada thistle is generally limited to mesic sites and is usually not found in the wetter areas of the fields or on the dry sagebrush uplands. Canada thistle is also found in limited abundance in the Mud Lake-Double O area of the refuge.

Whitetop is most commonly found near farm fields. It is located in the Mud Lake-Double O, and Sodhouse areas of the refuge. Its' present distribution on the refuge is limited to a few sites.

Perennial pepperweed was first reported on the refuge in September, 1980, and has been found at several locations in the Diamond Valley and near Buena Vista Station.

Under the provisions of state law (ORS 570.505 to 570.575), Harney County, by county court resolution, established a weed control district on July 7, 1965. The district includes the entire county and all of Malheur Refuge. The county court, through the weed control district has officially designated both Canada thistle and whitetop as noxious weeds which will be controlled throughout the county. Perennial pepperweed is listed as a noxious weed which should be eradicated.

The County Court has identified several species as noxious weeds and placed them in the following categories:

a. Eradicate (Present in Harney County)

Tansy ragwort (Senecio jacobaea)

Perennial pepperweed (Lepidium latifolium)

Diffuse knapweed (Centaurea diffusa)

Yellow star thistle (Centaurea solstitialis)

Klamath weed (Hypericum perforatum)

b. Eradicate (Not yet present in Harney County)

Mediterranean sage (Hypericum perforatum)

Leaffy Spurge (Salvia aethiopia)

Skeleton weed (Chondrilla juncea)

Halogeton (Halogeton glomeratus)

c. Control (Present in Harney County)

Dalmation toad flax	( <u>Linaria dalmatica</u> )
Russian knapweed	( <u>Centaurea repens</u> )
Scotch thistle	( <u>Onopordum acanthium</u> )
Medusa head wild rye	( <u>Elymus caput-meduoa</u> )
Puncture vine	( <u>Tribulus terresteis</u> )
Canada thistle	( <u>Cirsium arvense</u> )
Whitetop	( <u>Cardaria draba</u> )

The weed control program is presently administered by the Harney County Soil and Water Conservation District (SWCD). Since agriculture is an important part of the Harney County economy, local officials have expressed concern that Malheur Refuge comply with county weed control ordinances to control Canada thistle and whitetop.

Malheur Refuge has not signed a formal weed control agreement with Harney County. However, the refuge has entered into a formal soil and water conservation agreement with the Harney County SWCD which states in part 1(a) of page 2, "When lands administered by the Bureau (refuge) within the District (SWCD) are a contributing source of damage to other lands or when other lands within the District are a contributing source of damage to lands administered by the Bureau, proper priority shall be given to the areas contributing to the damage and steps will be taken by the responsible agency to remove such damage sources as rapidly as possible." The agreement was effective May 2, 1973.

Although the agreement does not specify noxious weed control, it does emphasize conservation and good land management which may be interpreted to include an active weed control program.

- D. Purpose: If allowed to spread uncontrolled, noxious weeds on Malheur Refuge could replace native vegetation over large areas, degrade natural wildlife habitat values, conflict with refuge objectives, and impede land management capabilities by making haying and cattle grazing no longer desirable or economically viable for refuge permittees.

The proposed action considered in this assessment would implement a management program at Malheur Refuge aimed at accomplishing the following objectives;

- 1) to enhance natural plant community of the refuge ecosystem by ensuring that pest plant treatment activities are necessary and ecologically sound;
- 2) to enhance the capabilities of refuge lands to produce desired wildlife outputs at economical costs by utilizing pest plant treatment methods having the greatest long-term effectiveness, and
- 3) to comply with state and county noxious weed control ordinances.

## ALTERNATIVES AND ENVIRONMENTAL CONSEQUENCES

### A. Alternative No. 1: The Preferred Alternative (Proposed Action)

1. Description: The abundance and distribution of noxious weeds on Malheur Refuge is affected by a complex array of environmental factors. The introduction of exotic pest plants on the refuge is generally the result of temporary ecological imbalances which allow these weeds to spread in an established eco-system. In most cases, this imbalance has been caused by a physical disturbance of the soil such as plowing for farm operations, construction of dikes, dams, nesting islands and roads, and the heavy concentration of cattle on some dikes, canal banks, and fence corners.

Because the noxious weed situation is complex and multifaceted, the U.S. Fish and Wildlife Service at Malheur Refuge proposes as the preferred alternative a broad, systematic approach utilizing all available information on the pest plants' ecology to develop a noxious weed management program that is con-

sistent with Service policy and refuge objectives. This proposal emphasizes that noxious weed management will, in most cases, focus on limiting plant abundance and distribution to a tolerable level, but eradication of some species will be necessary.

The proposed action stresses ecologically sound land management practices based on long-term effectiveness, minimal ecological disturbance, and a minimum hazard to non-target organisms. Land management practices will utilize physical, cultural, chemical, and/or biological alternatives, or combinations thereof, to manipulate the environment to the pest organisms' disadvantage. This will require detailed knowledge of the pest plant and its relationships to its' environment, familiarity with a wide range of control techniques, and pre-treatment and post-treatment monitoring of the effects of treatment efforts.

The use of chemicals (herbicides) is not viewed as the panacea to be relied upon as the primary technique in noxious weed management. Rather, herbicides are one of several land treatment options available and will be considered appropriate for use only if no feasible non-chemical alternatives are available. Herbicides will be used only to supplement rather than to substitute for weed limitation through good land use management.

The proposed action will be integrated into the existing land management program at Malheur Refuge in a manner that will not significantly conflict with attainment of refuge objectives. The implementation of the preferred alternative will initiate a multi-facted approach to noxious weed management in which refuge management and planning actions are undertaken with adequate review, and exploration of all feasible alternatives and a complete understanding of how those alternatives or combinations thereof may impact noxious weed distribution and abundance.

This proposal, herein referred to as the Integrated Pest Management (IPM) approach, is consistent with Service policy as outlined in the revised (draft) Refuge Manual (7 RM 11.1 - 11.10c), which when approved, will adopt and reflect the following policies and land management practices at Malheur Refuge.

a. Problem Analysis: The first step in IPM is the assessment of noxious weeds on the refuge to determine under what conditions the plant causes or threatens to cause damage or conflicts with the attainment of refuge objectives or the operations of adjacent landowners. Emphasis will be placed on determining those conditions which enhance the distribution and abundance of noxious weeds and on monitoring changes in plant vigor and locality.

b. Control Techniques:

(1) Irrigation: Annual flood irrigation of meadows and fields is an integral part of the habitat and wildlife management program at Malheur Refuge. It is known that standing water will inhibit the spread of , and in many cases will kill, existing stands of noxious weeds such as Canada thistle. Water held deep enough and long enough to kill thistle may be harmful to native grasses and forbs. However, this control technique could be used on sites with nearly pure stands of thistle. With the help of experts knowledgeable in the biology of Canada thistle, perennial pepperweed, and whitetop, guidelines will be developed and appended to this assessment which will prescribe the times of year of water application, water depth, and length of flooding which is most effective in limiting weed growth. Where the flooding guidelines are feasible and do not



conflict with other refuge objectives, they will be integrated into the irrigation program for fields heavily infested with noxious weeds. The primary purpose of irrigation will still be the enhancement of wildlife habitat; however, if the irrigation program can, with minimal conflicts, alterations or costs, be utilized to control noxious weeds, then such practices will be encouraged. This may simply involve holding irrigation for a longer period of time to drown the noxious weed. This approach could be followed on an experimental basis and its' effects monitored, before using it on a widespread basis.

- (2.) Excavation Rehabilitaion: Land management at Malheur Refuge frequently entails excavation of soil, gravel, rock and other earthen fill materials for the construction of waterfowl nesting islands, dams, roads, canals, and ditch banks. In addition, frequent maintenance activities such as cleaning ditches and canals places dredge spoils on levee tops. All these activities leave bare soils exposed to the early invasion of noxious weeds, particularly Canada thistle.

Whenever feasible, and within limitations dictated by budgetary and manpower constraints, such activities whether done by refuge staff, contractor, permittee, or co-operator, will be followed by a seeding of exposed ground. Seeding will utilize, whenever possible, vegetation native to the Malheur Refuge eco-system.

Emphasis will be given to seeding plants which are effective competitors of noxious weeds and which have additional value as food and cover for wildlife.

Efforts at rehabilitating all disturbed sites will be conducted. Seedlings will be monitored and evaluated for effectiveness in limiting weeds.

- (3) Fire: Prescribed burning is a land management treatment currently used on Malheur Refuge to manipulate vegetation and improve wildlife habitat. Fire may, under the proper conditions, adequately stress noxious weeds as to kill or limit their presence in some areas.

Professional advice and assistance from botanists and fire managers will be sought to develop guidelines which will identify those conditions in which fire might be lethal to Canada thistle, perennial pepperweed, or whitetop. A fire study is being conducted at this refuge which should provide some of these answers. Where major conflicts do not arise, and where these burning guidelines are compatible with other objectives, they will be used whenever a weed infested field is scheduled to be burned.

- (4) Mowing: Current mowing practices will be assessed to see if they are enhancing the spread of noxious weeds. Guidelines will be developed which will outline mowing treatments (primarily timing) most effective in controlling Canada thistle. Where conflicts are minimal and primary refuge objectives are not significantly compromised, spot control by refuge personnel of noxious weeds by mowing areas of 25 acres or less will be considered.

- (5) Farming Practices: It has been demonstrated that cultivation every 21 days can effectively control Canada thistle in grainfields (11). However, the grain farming at Malheur does not lend itself to this practice. Alfalfa farming, as an alternative, would pro-

vide good thistle control in farm fields. Refuge co-operative farmers will be encouraged to utilize non-chemical weed control techniques as an alternative to herbicides when and if such alternatives are developed. We know of none which can be used in the present farming program.

- (6) Chemicals: Herbicide treatment of noxious weeds may in some instances prove to be the most effective weed management alternative. Policies and premises which will govern the use of herbicides on Malheur Refuge include nine considerations of paramount importance - -

- (a) The human health and safety of refuge staff, visitors, permittees, and neighbors.
- (b) Maintenance of the biological community of the Malheur Refuge-Harney Basin ecosystem. If herbicides jeopardize either of these concerns, their use will not be allowed.
- (c) The most narrowly specific herbicide available for the pest in question will be chosen unless considerations of persistence or other hazards preclude that choice. Broadly toxic herbicides will be avoided in favor of substances that ideally are toxic only to a relatively narrow range of life forms. Mortalities among non-target species may preclude certain application techniques such as aerial spraying, which is difficult to control.
- (d) All uses of herbicides on Malheur Refuge will conform with Environmental Protection Agency regulations and registration information, label directions, State and local pesticide laws, and Department of Interior Pesticide policy.
- (e) All refuge personnel involved in any herbicide application

will be trained and certified in accordance with the Federal insecticide, Fungicide, and Rodenticide Act (FIFRA, Public Law 92-516) of 1972.

- (f) Where a refuge farming co-operator proposes to use any herbicide on refuge lands, that proposal will be subjected by the refuge manager and staff to the same scrutiny and examination of alternatives that a Fish and Wildlife Service proposal would receive.
- (g) All proposals for herbicide application will be approved in advance by the Regional Co-ordinator, Environmental Contaminants Evaluation (ECE) on Form 3-1976, Chemical Use Proposal.
- (h) Complete records of all herbicide treatments will be kept. Records will include common and chemical name, formulations, application rates, dates and times of treatment, target pest plants, and treatment sites.
- (i) In addition to herbicides, it has been demonstrated that chemical fertilizers, particularly nitrogen used with 2,4-D, can effectively control Canada thistle in farm fields (11). This fertilizer gives crop plants better growth to improve their competitive ability while the 2,4-D stresses the thistle. Guidelines for fertilizer application will be developed and appended to this assessment. Farming permittees will be encouraged to use this technique. Fertilizer application on refuge lands will be subject to the same scrutiny and process required for herbicides.

(7) Biological Controls: We are gathering information on biological controls for noxious weeds. Some controls are available and include a weevil which has been effective in controlling Canada thistle in some areas. Its' introduction will be considered in the IPM plan.

(8) Monitoring: Activities exercised under the proposed IPM will be monitored to evaluate the effectiveness of various treatment techniques in limiting noxious weeds and possible side effects (e.g. non-target mortalities). Where practical, pre-treatment baseline data is desirable. At a minimum this should include photos of the pre-treated areas.

Assessment monitoring should extend over a reasonable period of time and should yield quantitative data on mortality of the pest and other non-target organisms as well as regrowth following treatment.

## 2. Legal and Administrative Requirements of Special Concern:

a Threatened or Endangered Species: Two endangered birds, the bald eagle (Haliaeetus leucocephalus) and the American peregrine falcon (Falco peregrinus anatum) occur on the refuge, but there are no formally designated critical habitats here. Critical habitat will be delineated on adjacent lands for one plant, Malheur wire lettuce (Stephanomeria malheurensis). The peregrine falcon is a migrant species whose appearance on the refuge usually coincides with the fall and spring migrations of waterfowl and shorebirds. The peregrine falcon is a rare refuge visitor usually found near large concentrations of these birds.

The bald eagle on Malheur Refuge occurs as a spring and fall migrant as well as a winter resident. A few bald eagles spend the entire winter in the Blitzen Valley portion of the refuge. During the early spring water-

fowl migration (March-April), bald eagles are a common migrant species, particularly on Malheur Lake and in the Double O area.

Implementation of the preferred alternative would have no effects on either of these listed species or their habitats. Informal consultation was solicited from the Services' Endangered Species Specialist in the Area Office, Boise, on August 26, 1980. This co-ordination resulted in an informal concurrence that the proposed alternative would have no effects on either peregrine falcons or bald eagles. (8)

The state of Oregon has listed some plant species which grow in Malheur Refuge as threatened or endangered. An appended paper titled Rare, Threatened and Endangered Plant Observations, 1980, Malheur National Wildlife Refuge by Mark A. Stern identifies and gives locations of three such plants. No extensive plant surveys have been performed on Malheur and it is possible that other rare species may be found. Noxious weed control activities would be done only when the well being of those federal or state listed plant species determined as rare, endangered, or threatened, can be insured.

- b. Cultural Resources: Informal consultation was solicited from the State Historic Preservation Officer, Oregon State Parks, Salem on August 25, 1980 on possible conflicts with archeologic, historic or other cultural resources. No impacts are anticipated (5).
- c. Floodplains and Wetland Resources: Implementation of the preferred alternative would involve activities within the 100 year floodplain of the Blitzen River, Silver Creek, and possibly the Silvies River. Such activities would not increase flood hazards nor increase the potential for loss of life and property. The preferred alternative is consistent with the directives outlined in Presidential Executive Order 11988 on Floodplains.

Neither Canada thistle, whitetop, nor perennial pepperweed are aquatic plants which would normally be found in wetlands. Implementation of the preferred alternative would have no significant adverse effects on the natural values of refuge wetlands. The proposed action is consistent with the directives outlined in Presidential Executive Order 11990 on Wetland Protection dated May 24, 1977.

d Coastal Zone Resources: N/A

e Toxic or Hazardous Substances: The preferred alternative would not result in point source discharges of pollutants into a waterway. Consequently, consultation with the Environmental Protection Agency and/or the state regarding this problem is not necessary.

This alternative may however involve the use of toxic herbicides. Informal consultation was initiated with the Services' Regional Environmental Contaminant Co-ordinator in Portland on August 22, 1980 (10).

The result of this consultation were as follows:

- (1) If herbicides are used, refuge personnel should consult the Oregon Weed Control Handbook (Extension Service, Oregon State University, Corvallis, January 1980) for application rates, method of application, and herbicide type. The handbook is revised annually by O.S.U. and the current edition will be used.
- (2) Petroleum carrier mediums such as diesel oil should be avoided. They are often more persistent and environmentally damaging than the herbicide they dilute.
- (3) There are non-persistent herbicides that are proven effective in controlling Canada thistle, whitetop, and perennial pepperweed, but are relatively safe to fish, wildlife, and other organisms, and approved for use on refuges. These herbicides are 2,4-D, glyphosate, and di-

camba among others. The latter chemical is listed as restricted by the Department of Interior and would require special review and approval before use on Malheur refuge. Dicamba can kill fish, but proper application could avoid this problem. Glyphosphate is not a specific herbicide and can kill other plant species if not applied properly.

- (4) The climate of Malheur Refuge lends itself to a rapid breakdown of herbicides. Among these factors are heat, bright sunlight, and alkaline soils and water. For example, 2,4-D would be broken down in 3-6 weeks or less (15).
- (5) Wind drift can pose a problem for broadleaf non-target species such as willow. Selective spot control from the ground is generally safer and more desirable than broadcast treatments from the air. In either case, application on windy days should be avoided. Application guidelines for herbicides will be developed and appended to this plan.

Based on the above consultation, it has been informally reaffirmed that herbicide use is an acceptable alternative under the proposed action if no feasible non-chemical alternatives are available. To minimize conflicts with fish, wildlife, and habitat values, however, chemical use would require very restrictive application guidelines. If these guidelines are followed, herbicides could safely be used to limit noxious weeds in certain situations, improve wildlife cover, enhance wildlife benefits, and comply with state and county weed control ordinances in a manner consistent with Service policy and refuge objectives.

- f. Corps of Engineers' Section 10/404 Permits: Implementation of the preferred alternative would not involve structures, facilities, or the discharge of dredge or fill materials within, under, or above any waterway



or wetland, Consequently, Corps of Engineers' permits are not applicable to the proposed action.

3. Important Resource Effects

- a. Fish and Wildlife Resources: Wildlife diversity is generally directly related to plant diversity. The preferred alternative would limit the presence of noxious weeds and during the short term could limit plant/wildlife diversity.

American goldfinches are known to eat Canada thistle seeds. Weed seeds and plant parts may also be eaten by small rodents, mourning doves, and other granivorous birds. Implementation of the preferred alternative would limit the presence of noxious weeds and reduce this source of food to these animals. This represents a trade-off in wildlife benefits for species such as goldfinches which probably benefit from the presence of Canada thistle. Some food sources would be replaced as native plants revegetated sites previously occupied by noxious weeds.

Canada thistle and whitetop commonly grow in dense stands which make excellent nesting cover for ducks, pheasants, and many species of ground nesting birds. In addition, the rank growth and thorns of Canada thistle present a real deterrent to both terrestrial and avian predators. Thus, noxious weeds have an added benefit of providing excellent escape cover where broods of young birds and litters of young mammals can elude their predators. The proposed alternative would limit noxious weeds and reduce these benefits. This loss would be minor and short term since the limitation of weeds would allow the re-establishment of native vegetation which would replace most of the lost nesting and escape cover provided by weeds.

Since weed stands are often avoided by grazing cattle, predators, and permittees who mow refuge hay, they provide excellent escape cover for small

mammals. These small animals are particularly important as the prey base for many refuge predators and play a key role in supporting an abundant and diverse population of wintering raptors. The preferred alternative would limit weed stands and possibly have secondary impacts on rodent and raptor populations.

The distribution of perennial pepperweed on the refuge is limited such that its' benefit to wildlife as cover or a food source are negligible.

- b. Human Health and Safety: The proposed action would initiate the use of several alternatives, some of which potentially could present threats to human health and safety, particularly to those involved in the chemical treatment process. Cultivation with heavy farm equipment, prescribed burning, and herbicide application all present possible hazards. By following label directions on herbicides and exercising normal safety precautions around equipment and fire, these hazards should be minimized to an acceptable level.
- c. Energy Resources: The preferred alternative would require an increased expenditure of gasoline, diesel fuel, and other petroleum products necessary to move vehicles and farm equipment required for weed treatment. Initial fuel expenditures may be substantial. However, if various land practices begin to affect and limit weed abundance, this impact should diminish to a level of minor consequence.
- d. Economics: Noxious weed management on Malheur Refuge would increase the quantity and quality of forage plants available to refuge grazing and haying permittees. Increased yields in beef and hay production would improve the cost effectiveness of ranch operations for refuge permittees and increase their profits. Similar benefits are expected for farming permittees.

In addition , to the extent that the refuge may be contributing to weed

problems on neighboring lands, the preferred alternative could possibly lessen the amount of effort and costs associated with weed control on lands adjacent to the refuge.

The proposed alternative could involve the issuance of contracts or the hiring of temporary help which would have short term though minor impacts on local employment. No impacts are anticipated on local property values or taxes.

The proposed alternative would place a new and substantive demand on the refuge budget and manpower. The main areas requiring refuge resources are:

- (1) Problem Analysis: Considerable staff time would be required in defining the problem area. Photo plots, transects, ground checks, enclosures, etc., would have to be established to determine: a) the extent of the weed problem, b) conditions which enhance or detract weed abundance, and c) whether the weed is increasing, decreasing, or static.
- (2) Development of Control Guidelines: Several techniques will require substantial amounts of staff time to develop guidelines and recommendations on how each treatment can most effectively limit weed abundance. Guidelines and recommendations for burning, flooding, mowing, spraying, etc., will have to be developed which will specifically address application rates, procedures, chronology, etc.. Extensive co-ordination, and possibly contracts, with weed management specialists, botanists, fire technicians, and other knowledgeable experts will be required to develop these guidelines.
- (3) Implementation: In some instances (e.g. mowing), actual implementation can be conducted by permittees at little direct cost to the refuge. Other techniques, though done by refuge staff, are relatively inexpensive and already part of the on-going refuge program. A-

mong these are prescribed burning and flood irrigation.

Two areas of the proposed alternative which would place major demands on refuge resources are herbicide spraying and seeding disturbed soil sites. Both techniques are expensive (chemicals, seed, fertilizer), require additional equipment and maintenance (tractors, sprayers, grain drills), and are labor intensive. Spraying requires bi-annual treatment over a 2 - 4 year period.

- (4) Monitoring: Follow-up monitoring to evaluate the effectiveness of each weed treatment will require great amounts of staff time. Photo plots, transects, etc., will require annual attention. Reports, evaluations, and recommendations will also require additional staff time.

A final area of concern is timing. Much of the work in the proposed alternative falls during the summer months, one of the busiest times of the year for the refuge. Unless additional funds or staff were provided to implement and monitor the proposed alternative, major trade-offs or compromises in the on-going refuge program would be necessary.

- e. Aesthetics: Several treatment practices under the preferred alternative would involve activities which would cause impacts to the aesthetics of Malheur Refuge. Burning would create smoke and leave fields in a blackened condition. Cultivation and mowing creates noise, dust, and possible visual impacts. Herbicide application may generate offensive odors, noise, and unsightly stands of dead and dying vegetation. All aesthetic impacts are short term and can be minimized to acceptable levels through spatial (e.g, road closures) and temporal (e.g, burning during periods of low visitor use planning.

- f. Air Quality: Noxious weed treatment by prescribed burning could have significant short term impacts on air quality. Prescribed burning plans for each field to be treated would address this problem. Burning would be conducted when weather conditions provided optimum opportunities for smoke dispersal (e.g no inversion layer and slight breeze). The very low population densities around Malheur Refuge limits the impact of smoke on air quality.

Other treatment practices such as cultivation and herbicide spraying could affect air quality by creating contamination by dust or volatile chemical fumes. Such impacts would be minor and short term.

- g. Water Quality: Herbicide spraying along canals, ditch banks, on nesting islands, or near wetlands, could potentially affect water quality through careless application techniques. Although such impacts are generally short term, chemicals have the potential of causing significant damage to aquatic organisms. Consequently, if herbicides are utilized near water they will be applied only by trained and certified employees of the refuge staff who are knowledgeable about proper treatment techniques. Proper training and careful application should minimize these hazards to an acceptable level.

- h. Land Use Compatibility: All noxious weed treatment practices outlined in the preferred alternative are presently being utilized to some degree in the land management program at Malheur Refuge. These practices, under the right circumstances and supervision are compatible with present land use and refuge objectives.

In many cases a noxious weed treatment practice may temporarily impact wildlife resources or conflict with refuge land use objectives.

Prior to such treatment a thorough examination of all alternatives will be conducted to critically weigh the trade-offs between short term losses and long term benefits to refuge habitats and animals.

- i. Education/Recreational Opportunities: The preferred alternative would initiate an integrated pest management program that can serve as a model to other refuges, land managers, and to the visiting public that pest plants can be limited and managed at tolerable levels through land use management practices based on sound ecological principals. This preferred alternative would provide several opportunities to incorporate noxious weed management treatments into the interpretation and environmental education programs to study the relationship of pest plant management and the ecology of the refuge.

No major conflicts are anticipated between the preferred alternative and recreational or educational opportunities.

B. Alternative #2: No Action

1. Description: Under this alternative, traditional land use practices such as irrigation, haying, and cattle grazing would continue. No active management would be conducted to limit, control, or eradicate noxious weeds on Malheur Refuge.
2. Legal and Administrative Requirements of Special Concern:
  - a. Threatened or Endangered Species: No impacts
  - b. Cultural Resources: No impacts
  - c. Floodplain and Wetland Resources: No impacts
  - d. Coastal Zone Resources: N/A
  - e. Toxic or Hazardous Substances: N/A
  - f. Corps of Engineers' Section 10/404 Permits: N/A
  - g. State and County Weed Control Laws: The "No Action" alternative would put us in violation of Service policy which provides for compliance with State and county weed control laws whenever possible.

### 3. Important Resources Effects:

- a. Fish and Wildlife Resources: Under this alternative, noxious weeds, where they are effectively competitive, would be allowed to spread and replace native vegetation. If noxious weeds increased significantly, the following adverse impacts are possible: 1) Large monotypic stands of noxious weeds could decrease overall plant diversity and subsequently affect wildlife diversity by decreasing availability of desirable food plants. 2) Noxious weeds may replace valuable nesting and escape cover, thus affecting several species of ground nesting birds and small mammals which prefer native vegetation. It should be noted, however, that noxious weeds may provide habitat for other wildlife. 3) Weeds would be allowed to grow unchecked in grain-fields, resulting in diminished capability to feed and maintain fall populations of greater sandhill cranes, Canada geese, and ducks. 4) The increased presence of weeds would impact land management practices such as mowing which would have secondary impacts on wildlife e.g. fewer mowed meadows for goose browse or sandhill crane feeding and an increased chance that early nesting species would be flooded out in meadow areas.

The no action alternative together with the possible increase in noxious weeds could have the following beneficial impacts on fish and wildlife resources; 1) Noxious weeds provide a preferred food source to some types of wildlife e.g. goldfinches and possible mourning doves (12). 2) Weeds provide excellent nesting and escape cover. 3) Refuge wildlife would not be disturbed by weed treatment practices such as spraying, burning etc., i.e. optimum seclusion and protection with a minimization of disturbance. 4) To the extent that weed stands would attract and hold increased small mammal populations, this alternative could benefit wintering raptor populations

which are known to respond favorably to the presence of this primary prey source.

- b. Human Health and Safety: No impacts
- c. Energy Resources: Since this alternative involves no active weed treatment activities, overall fuel consumption would be decreased in the following areas: 1) Refuge fuel consumption would decrease as present spraying programs were curtailed. 2) Farming co-operators would stop weed spraying in refuge grainfields, thus reducing their fuel consumption. 3) Finally, as weeds became more prevalent, fuel consumption by mowing permittees would decrease as they began cutting fewer acres in each field.
- d. Economics: This alternative would benefit Malheur Refuge in the short term by eliminating the present cost associated with weed spraying by refuge staff. This benefit would be offset by the following adverse impacts;
  - (1) As weeds increase, the quantity and quality of forage available to grazing and haying permittees would decrease, thus causing the profitability of such operations to adversely impact ranchers. Under the most adverse conditions (a pure stand of noxious weeds), the economic impact would be total, i.e. no desirability for haying or grazing.
  - (2) Elimination of weed control may allow noxious weeds to freely compete with cereal grains in farm fields. Decreased grain yield and increased weed seed contamination would impact the profitability of refuge co-operators.
  - (3) This alternative could have economic impacts on neighboring lands. First, as weeds increased in abundance, the probab-



ity of seed contamination via refuge hay hauled to private land would increase. Also, opportunities for direct contamination by seeds and other plant parts from the refuge to adjacent neighbors would increase. Both situations could have economic impacts on private operations by increasing their costs.

- e. Aesthetics: The increased presence of large stands of noxious weeds may be less visually appealing to refuge visitors than native vegetation.

Because the no action alternative does not include any active weed treatment practices, some aesthetic impacts such as dead vegetation, odor, dust, noise, etc. would be avoided. Other aesthetic impacts are not anticipated.

- f. Air Quality: No impacts

- g. Water Quality: No impacts

- h. Land Use Compatibility: The no action alternative could have significant impacts on refuge land use. Permittee reluctance may gradually evolve to outright refusal to mow or graze heavily infested fields, thus hindering the management flexibility to manipulate vegetation for goose browse, sandhill crane feeding meadows, and cover for ground nesting birds. The same impacts may occur in grainfields with the cooperative farming permittees.

- i. Educational/Recreational Opportunities: No impacts

C. Alternative #3: Maximized Weed Spraying

1. Description: Under this alternative, present land use practices including flood irrigation, haying, cattle grazing, co-operative farming, and prescribed burning would continue. However, herbicide spraying would be maximized to control noxious weeds on the refuge. Only herbicides approved by the U.S. Department of Interior would be allowed and application would rigidly follow label directions and Service policy.

2. Legal and Administrative Requirements of Special Concern:

a. Threatened or Endangered Species: The two threatened or endangered birds on Malheur Refuge are the migrant peregrine falcon and bald eagle. Both species are susceptible to persistent pesticides which pass through the food chain to concentrate in the tissues of carnivores such as these.

As mentioned on page 13 of this document, three plants listed by the State of Oregon as rare, threatened, or endangered occur here. The use of chemicals would be restricted to provide complete protection for these plants.

Only non-persistent, rapidly bio-degradable herbicides are sanctioned for use on refuge lands. In addition, only chemicals narrowly specific to the pest plant would be used. Herbicides that are toxic to a wide range of non-target species would be generally prohibited under this alternative. However, it may be desirable to use such chemicals under specific conditions where a noxious weed may be found in extensive, monotypic stands and cannot be controlled by other means.

Thus, no impacts to threatened or endangered species are anticipated. However, the broad use of any chemical always leaves open the possibility of some yet undiscovered and subtle impact that may not manifest itself for several years after application.

- b. Cultural Resources: No impacts
- c. Floodplain and Wetland Resources: Chemical application always presents the possible threat that herbicides will be carried to non-infested sites by wind drift or by surface waters. In both situations the biological integrity of wetlands could possibly be compromised if unintentional plant or animal mortalities occurred through careless application or accident.
- d. Coastal Zone Resources: N/A
- e. Toxic or Hazardous Substances: This alternative would involve the broad application of toxic herbicides. It should be noted, the term "toxic" as used here includes only those chemicals toxic to the target species or whose toxic effects on non-target organisms is known and can be controlled through proper application. Informal consultation with the Services' Regional Environmental Contaminant Evaluation (ECE) Co-ordinator was conducted on August 22, 1980 (10). The following points were raised during this consultation; 1) This alternative violates basic Service policy which states that chemicals will be authorized only when no feasible alternatives exist and when it can be determined that such use is environmentally safe. 2) There are other non-chemical alternatives available to limit noxious weeds on Malheur Refuge. 3) There are approved herbicides which could effectively limit noxious weeds at Malheur Refuge that are environmentally safe and non-toxic to fish and wildlife. 4) Under no circumstances should petroleum products such as diesel fuel be used as the carrier medium for herbicides. The toxicity and environmental hazards of such materials often exceeds the herbicides they dilute. 5) Widespread aerial application of herbicides is risky and non-target mortalities are difficult to control. Whenever possible, selective ground application is preferable to broad-

cast aerial application.

Another possible impact is that of synergistic toxicity. Some herbicides which are relatively safe in the environment can, when mixed with other herbicides, undergo chemical changes such that the mixture takes on hybrid characteristics totally different than either of the parent materials. 8) This phenomenon could be a problem if more than one herbicide was applied in a given area or if spray equipment was not thoroughly cleaned when changing from one chemical to another.

f. Corps of Engineers Section 10/404 Permits: N/A

3. Important Resource Effects

a. Fish and Wildlife Resources: For herbicides to be most effective in limiting noxious weeds such as Canada thistle, white top, and perennial pepperweed, an early application while the plant is still in the bud stage is recommended (4,6,11,12,14,15,17). At Malheur Refuge this would generally be early July for thistle, and mid-late May for white-top and perennial pepperweed, with year-to-year fluctuations due to weather. Since aerial application is considered too environmentally risky (10), application would have to be accomplished on the ground from tractors, vehicles, or hand sprayers.

Such spraying activities would present a major disturbance to ground nesting birds. Nesting chronology data developed at Malheur Refuge indicates that early July is the peak hatching period for some of the more common nesters such as cinnamon teal, gadwall, and redhead (13). Spraying at this time would cause widespread disturbance by flushing incubating hens, nest abandonment, and possible nest destruction by spray equipment. Such disturbance is particularly devastating to these late nesting species because treatment would not allow these birds the opportunity to renest.

Earlier spraying would be even more disruptive by affecting both the hatching period of the early nesters (e.g. mallards, sora rails) and the egg laying periods of the later nesters (e.g. gadwalls, cinnamon teal). Spraying later in July would minimize impacts to ground nesters but would not be effective in killing the pest weeds (16).

Since most meadows and fields are still flooded in early July, this alternative would require major changes in irrigation schedules to allow for earlier dewatering. Early drying of fields would result in major conflicts with nesting birds. Feeding and brood rearing habitat for duck broods would be eliminated. Broods would be forced out of the dry fields to large impoundments, ditches, and canals. Early dewatering would impact young sandhill crane chicks which rely on wet meadows for feeding. A whole host of aquatic birds, including coots, rails, Canada geese, herons, egrets, bitterns, and ibis would be similarly impacted by the early loss of either nesting, feeding, resting, or brood-rearing habitats.

If early dewatering was conducted over a large area, the impacts would be significant. Furthermore, to be truly effective in limiting weeds such as Canada thistle, some chemicals such as 2,4-D have to be applied for 4 continuous growing seasons before significant results become apparent (11). The cumulative adverse effect of 4 years impacts on any given field due to early dewatering and spraying during the nesting season would unquestionably be great.

This alternative deals with maximized spraying. It should be remembered that limited spraying in conjunction with other weed control techniques as delineated in alternative #1 is probably the most desirable and effective form of noxious weed control known at this time.

Herbicides are generally toxic to plants other than the target species. For example, 2,4-D, commonly recommended for Canada thistle control, is also toxic to several other broadleaf plants. Thus, non-target plant mortalities in the treatment area would affect native plant community composition and would impact wildlife by reducing food and cover plants.

Herbicides would benefit some species of wildlife on Malheur Refuge by reducing the presence of noxious weeds and allowing the re-establishment of native grasses and forbs which may have greater value for food and nesting cover. Herbicides would make fields more desirable to permittees for haying and grazing, thus allowing refuge staff the flexibility to use these practices to benefit wildlife.

Herbicides would increase grain yields from farming operations. More food would be available for sandhill cranes and Canada geese in the fall.

- b. Human Health and Safety : This alternative would increase the probability of human health and safety hazards, primarily for those involved in direct application. Possible hazards include inhalation of chemical fumes, skin irritations or allergic reactions by direct contact, and accidental ingestion. Also, there is the possibility of long term health difficulties which are unknown to medical science today.
- c. Energy Resources: This alternative would greatly increase the amount of fuel now expended by refuge trucks and farm equipment involved in weed spraying.

- d. Economics: This alternative would have positive economic impacts for haying and grazing permittees. Removal of noxious weeds would improve the quantity and quality of hay and forage, making both haying and grazing more profitable for permittees. In addition, this alternative would decrease the possibility of off-refuge weed contamination which could decrease the cost of future weed control on private land.

This alternative would decrease the presence of noxious weeds in grainfields which would also improve the profitability of such operations for cooperative farmers.

This alternative would have a large and adverse impact on the refuge budget. Purchase of large quantities of herbicides would represent a significant new overhead cost in refuge operations. In addition, herbicide application under this alternative is labor intensive and would annually require several weeks by skilled, certified, and well-trained employees. Unless additional allocations were received to supplement the budget and the work force, this alternative would be a major burden on the refuge. On-going programs and activities of a higher resource priority would be postponed or left undone during the spraying period.

- e. Aesthetics: There would be several aesthetic impacts associated with this alternative. The most significant factor would be the visual impact of dead and dying vegetation. Other impacts, though minor, would be the noise associated with spraying equipment and the odor of herbicide fumes.

- f. Air Quality: There would be temporary and minor adverse impacts associated with spraying activities and the fumes from the herbicides.
- g. Water Quality: This alternative could possibly affect water quality if herbicides were accidentally sprayed over wetlands or open waters. Surface waters on the refuge are not used for domestic drinking so ingestion or contaminated water would not be a problem. Also, the short life expectancy of approved herbicides together with a rapid dilution and dissipation factor would negate most water quality problems should they occur.
- h. Land Use Compatibility: Herbicides would limit noxious weeds and allow for the re-establishment of native vegetation. Since only environmentally safe herbicides would be used under this alternative, no conflicts with present land use are anticipated. Native vegetation is viewed as more desirable than exotic noxious weeds and the re-establishment of native plants is certainly compatible with refuge objectives and land use.
- i. Educational/Recreational Opportunities: This alternative may provide opportunities to demonstrate to the visiting public and other land managers how herbicides can safely play a role in maintaining the ecological balance and management objectives of Malheur Refuge.

D. Alternative #4: Annual Mowing

- 1. Description: Under this alternative, infested fields (primarily Canada thistle) would be mowed annually to control these pest plants. Mowing would be conducted by permittees in early to mid-July while Canada thistle is most vulnerable (bud stage). Infested fields which were idle (no haying or grazing) would be taken out of non-use and mowed annually.



The annual mowing treatment would continue until substantive control of noxious weeds occurred. This would generally be a 2 to 4 year treatment cycle (11). Following the mowing cycle, fields could be returned to other land use treatments e. g. non-use, or delayed haying dates. Herbicides would not be used under this alternative. This alternative would address only those weed problems present in meadows and hay fields. It would not include weed problems in grain-fields where haying is not a normal practice or along roadsides, ditch banks, etc..

2. Legal and Administrative Requirements of Special Concern:

- a. Threatened or Endangered Species: No impacts.
- b. Cultural Resources: No impacts.
- c. Floodplain and Wetland Resources: No impacts.
- d. Coastal Zone Resources: N/A.
- e. Toxic or Hazardous Substances: No impacts.
- f. Corps of Engineers Section 10/404 Permits: No impacts.

3. Important Resource Effects

- a. Fish and Wildlife: Under this alternative present habitat management practices would undergo three major changes: 1) Infested fields in non-use would be taken out of deferrment and annually mowed for 2 to 4 years or until weeds were limited to tolerable levels. 2) Haying in infested fields would commence up to 40 days sooner than present policy allows. 3) Infested fields would require earlier dewatering to allow for earlier haying.

A change from non-use (no haying or grazing) to annual mowing would result in detrimental impacts to ground nesting birds, particularly ducks. These impacts would include lower duck nest

densities, lower nest success, and lower overall production, (9) Since weed control by annual mowing would require 2 to 4 years, these impacts would be cumulative. Data on other ground nesters is not available; however, similar impacts would be expected for coots, rails, short-eared owls, and blackbirds, among others. This is a broad statement and does not necessarily rule out the possibility that some fields with severe thistle problems could be mowed earlier with relatively little loss in net waterfowl production. This could not be done on an extensive basis during any one year.

Fields in non-use are known to support higher numbers of small mammals than mowed fields. Thus, any reduction in idle lands would also impact winter raptor populations and mammalian predators which rely on these prey species.

Increased annual mowing would benefit some wildlife species. Goose browse would increase and more feeding areas for sandhill cranes would result. Mowed areas, particularly if they are flooded early, are used more heavily during spring waterfowl migration than idle lands.

Early dewatering, which would be required to facilitate early mowing, would have several detrimental impacts on wildlife. As fields dried, most of the water-associated species of the refuge would lose either feeding, resting, nesting/breeding, or brood rearing habitat. Among those most severely impacted would be herons, egrets, American bittern, sandhill cranes, rails, coots, waterfowl, gulls, grebes, muskrats, mink, raccoons, and numerous aquatic invertebrates and plants. Early dewatering could cause nest abandonment for over water nesters such as redheads, coots, and grebes. Early loss of brood water in sloughs and fields would

increase the vulnerability of young flightless birds to loss from predation, accidents, stranding, abandonment, etc..

There are little or no wildlife benefits associated with the early dewatering of meadows and fields.

For annual mowing to effectively stress Canada thistle, harvesting should take place in early to mid-July. Early mowing would be detrimental to wildlife by: 1) reducing the overall amount of escape cover available for young broods and litters, 2) disrupting or killing broods and litters, and 3) causing nest destruction, abandonment, or direct mortality to nesting hens.

Several species including blackbirds, phalaropes, rails, and meadowlarks use dewatered fields and meadows for brood rearing. If these young birds survive the mowing equipment, they are immediately and openly exposed to predators (particularly gulls and ravens) which dispatch them readily.

Early mowing would also be a detriment to incubating hens and their nests. Impacts would vary by species and by the prevailing land use treatment in each field. Recent research on the refuge has documented duck nesting densities, chronologies, and hatching successes for various habitat management practices. (9)

The greatest impact of early haying would be felt by late nesting species in non-use fields. If haying began on July 15, between 60 and 66 percent of all gadwall hens nesting in non-use fields would still be on the nest. This represents approximately 8 nests/100 hectares or 1 nest/30 acres assuming no nest loss to other causes occurs. Data for redheads is not available to quantify possible

impacts; however, because they are late nesters (peak hatching is July 9-16), early haying would also be particularly detrimental to this species (13).

With a July 1 haying date, 50% of all mallards which nest or re-nest in idle fields are still on the nest (9). This represents a density of 3 nests/100 hectares or 1 nest/83 acres assuming no mortality to other causes occurs.

Thus, earlier haying dates are more detrimental because they coincide with the hatching/brooding period of early nesters and the laying/incubation period of the late nesters (gadwall, teal). This impact would be felt by most of the ground nesting birds common in the fields and meadows of the Blitzen Valley and would be cumulative over the span of the treatment period (2-4 years).

Early mowing is not without its benefits to wildlife. It is an effective technique to control noxious weeds (particularly Canada thistle). The quality and abundance of native plant communities could be maintained which, in turn, would provide food and cover for an abundant diversity of animals. This would include browse areas for Canada geese.

- b. Human Health and Safety: No impacts
- c. Energy Resources: This alternative would increase expenditure of gasoline and other petroleum products used by mowing equipment and by refuge vehicles used to administer haying operations and monitor treated fields. Fuel expenditures would be high during the 2-4 year cycle and would decline as treated fields were retired to non-use. However, in the long term, this alternative would require continued expenditures of energy resources.

- d. Economics: This alternative would have positive impacts on refuge haying and grazing permittees. Annual mowing would cause a decline in noxious weed abundance which in turn would improve the quality and quantity of hay and forage. In addition, early haying would allow permittees to harvest hay when the protein content is higher. Both factors would increase the profitability of permittee operations.

As noxious weeds declined under this alternative, off refuge impacts caused by hauling refuge hay or by seed dispersal would diminish. This could alleviate weed control costs now encumbered by neighboring ranchers.

This alternative would have a negative impact on existing refuge budgets and manpower. Infested fields would have to be closely monitored by photo plots, plant transects, and ground checks to determine which fields needed treatment. Post treatment monitoring by similar methods would also be required. Actual administration of the haying program would require additional overhead expenses.

- e. Aesthetics: Mowing does involve noise, dust, and visual impacts but these are short term and minor.
- f. Air Quality: No impacts.
- g. Water Quality: No impacts
- h. Land Use Compatibility: This alternative was a common land use treatment on the refuge for a number of years. It is compatible with present land use; however, it does conflict with attainment of some major refuge objectives, primarily migratory bird production and maintenance.

i. Educational/Recreational Opportunities; No impacts.

PUBLIC INVOLVEMENT AND COORDINATION-INFORMAL STAGE

A. Federal, State, Local Governments (Specify)

1. Oregon State University
2. County Extension Agent
3. U.S.F.W.S., (Environmental Specialist, migratory bird coordinator, AM)
4. Oregon Fish & Wildlife Department
5. Harney County Court

B. Environmental Groups (Specify)

1. Defenders of Wildlife
2. Oregon Environmental Council

C. Economic Interest Groups (Specify)

1. Ranchers for Conservation
2. Chamber of Commerce

D. All Refuge Permittees

#### IV. SELECTION OF THE PREFERRED ALTERNATIVE

Decision Making Criteria	1. Int. Pest Mgmt.	2. No Action	3. Max. Herbicide	4. Annual Mowing
Does it solve the problem for:				
C. Thistle	Yes	No	Yes	Yes
Whitetop	"	"	"	No
P. pepperweed	"	"	"	No
Threatened/End. Sp.	0	0	0	0
Wildf. Diversity	?-	?-	-	?-
Production: ground nesting birds	+	?-	--	--
Maint: water birds	0	?-	--	--
Maint: winter raptors	?-	+	-	-
Maint: sandhill cranes fall migration	+	-	+	0
Maint: goose fall & spring migration	+	-	+	+
Fish & Aquatic Organisms	0	0	?-	0
Plant Diversity	?+	?-	--	?-
Native Plant Communities	+	--	--	?-
Economics-Haying & Grazing Permittees	+	--	++	++
Economics-Farming Permittees	+	--	++	?-
Economics-Refuge Operations	-	?-	--	-
Cultural Resources- Historic & Archeologic	0	0	0	0
Toxic/Hazardous Substances	?-	0	?-	0
Human Health & Safety	?-	0	?-	?-
Energy Resources	?-	0		

#### IV. SELECTION OF THE PREFERRED ALTERNATIVE (CONTINUED)

Decision Making Criteria	ALTERNATIVES			
	1. Int. Pest Mgmt.	2. No Action	3. Max. Herbicide	4. Annual Mowing
Aesthetics	?-	?-	-	?-
Air Quality	?-	0	?-	0
Water Quality	?-	0	?-	0
Land Use Compatibility	0	0	0	0
Education/Recreation	?+	0	0	0
Support:				
Permittees/Local Govt.	?	Low	High	High
General Public	?	?	Low	?
Agency (FWS)	High	?	Low	Low
Controversy:				
Permittees/Local Govt.	?	High	Low	Low
General Public	?	?	High	?
Agency (FWS)	Low	?	High	High

#### Legend:

- + Beneficial
- ++ Very Beneficial
- ?+ Possibly Beneficial
- 0 No Impacts
- Adverse
- Very Adverse
- ?- Possibly Adverse

IPM was selected as the best approach to noxious weed control on this refuge for several reasons. This program will cause the least amount of direct disturbance to the refuge. A mowing-only program would produce increased mortality in nesting birds due to destruction and the chemical control alternative would cause some loss of refuge from direct contact with herbicides. There would be less expense and environmental impact with the IPM alternative. For these reasons the IPM would probably have the best public acceptance, also.